

# Vocal Emotion Recognition: A Comparison of Singers and Instrumentalists, Amateurs and Professionals

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## Supplemental Tables and Figures

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## 1. Supplemental Results

**Table S1 – Bayesian Repeated Measures ANOVA (Singers vs. Instrumentalists)**

Models	P(M)	P(M data)	BF <sub>M</sub>	BF <sub>10</sub>	error %
Emotion + MType + Emotion * MType	0.053	0.808	75.897	1.000	
Emotion + MType + Group + Emotion * MType	0.053	0.130	2.701	0.161	2.042
Emotion + MType + Group + Emotion * MType + Emotion * Group	0.053	0.054	1.036	0.067	3.630
Emotion + MType + Group + Emotion * MType + MType * Group	0.053	0.005	0.088	0.006	3.103
Emotion + MType + Group + Emotion * MType + Emotion * Group + MType * Group	0.053	0.002	0.033	0.002	2.468
Emotion + MType + Group + Emotion * MType + Emotion * Group + MType * Group + Emotion * MType * Group	0.053	1.600×10 <sup>-4</sup>	0.003	1.979×10 <sup>-4</sup>	6.094
Emotion + MType	0.053	4.463×10 <sup>-24</sup>	8.034×10 <sup>-23</sup>	5.522×10 <sup>-24</sup>	2.680
Emotion + MType + Group	0.053	6.564×10 <sup>-25</sup>	1.182×10 <sup>-23</sup>	8.121×10 <sup>-25</sup>	2.251
Emotion + MType + Group + Emotion * Group	0.053	2.308×10 <sup>-25</sup>	4.155×10 <sup>-24</sup>	2.856×10 <sup>-25</sup>	3.079
Emotion + MType + Group + MType * Group	0.053	2.684×10 <sup>-26</sup>	4.832×10 <sup>-25</sup>	3.321×10 <sup>-26</sup>	14.133

Note: All models include subject, and random slopes for all repeated measures factors.

Note: Showing the best 10 out of 19 models.

*Note. For interpretation of the output, refer to van den Bergh et al. (2020)*

**Table S2 – Bayesian Repeated Measures ANOVA (Professionals vs. Amateurs vs. Non-Musicians)**

Models	P(M)	P(M data)	BF <sub>M</sub>	BF <sub>10</sub>	error %
Emotion + MType + Emotion * MType	0.053	0.870	120.156	1.000	
Emotion + MType + Group + Emotion * MType	0.053	0.122	2.495	0.140	4.243
Emotion + MType + Group + Emotion * MType + Emotion * Group	0.053	0.005	0.082	0.005	2.941
Emotion + MType + Group + Emotion * MType + MType * Group	0.053	0.004	0.070	0.004	2.480
Emotion + MType + Group + Emotion * MType + Emotion * Group + MType * Group	0.053	1.492×10 <sup>-4</sup>	0.003	1.715×10 <sup>-4</sup>	2.922
Emotion + MType + Group + Emotion * MType + Emotion * Group + MType * Group + Emotion * MType * Group	0.053	2.669×10 <sup>-7</sup>	4.804×10 <sup>-6</sup>	3.069×10 <sup>-7</sup>	2.457
Emotion + MType	0.053	1.444×10 <sup>-53</sup>	2.599×10 <sup>-52</sup>	1.660×10 <sup>-53</sup>	2.095
Emotion + MType + Group	0.053	1.705×10 <sup>-54</sup>	3.069×10 <sup>-53</sup>	1.961×10 <sup>-54</sup>	5.388
Emotion + MType + Group + Emotion * Group	0.053	4.577×10 <sup>-56</sup>	8.239×10 <sup>-55</sup>	5.263×10 <sup>-56</sup>	3.204
Emotion + MType + Group + MType * Group	0.053	3.260×10 <sup>-56</sup>	5.868×10 <sup>-55</sup>	3.748×10 <sup>-56</sup>	5.269

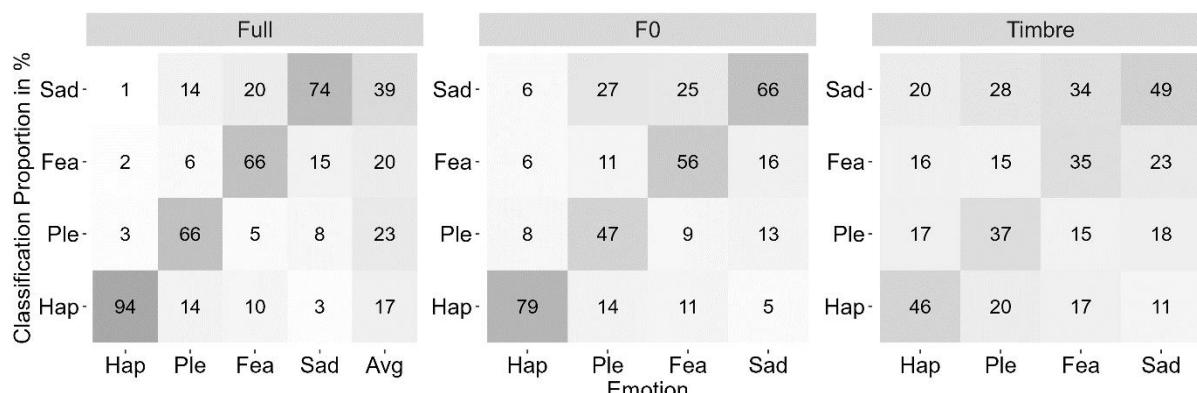
Note: All models include subject, and random slopes for all repeated measures factors.

Note: Showing the best 10 out of 19 models.

*Note. For interpretation of the output, refer to van den Bergh et al. (2020)*

**Figure S1**

*Confusion data for each Emotion for the three Morph Types – Singers and Instrumentalists*



*Note. Numbers represent the proportion of classification responses per Emotion and Morph Type, averaged across musicians. Hap = happiness, Ple = pleasure, Fea = fear, Sad = sadness, Avg = average.*

**Figure S2**

*Confusion data for each Emotion for the three Morph Types – Singers only*

Classification Proportion in %	Full					F0				Timbre				
	Sad-	Hap	Ple	Fea	Sad	Sad-	Hap	Ple	Fea	Sad	Sad-	Hap	Ple	Fea
	1	13	19	75	38	6	28	25	66	21	29	33	48	
Fee-	1	6	67	16	21	7	11	56	16	14	16	37	23	
Ple-	3	66	4	6	22	7	45	7	12	15	33	13	16	
Hap-	95	15	9	3	19	81	16	11	6	50	22	17	13	
	Hap	Ple	Fea	Sad	Avg	Hap	Ple	Fea	Sad	Hap	Ple	Fea	Sad	
	Emotion					Emotion				Emotion				

*Note. Numbers represent the proportion of classification responses per Emotion and Morph Type, averaged across non-musicians. Hap = happiness, Ple = pleasure, Fea = fear, Sad = sadness, Avg = average.*

**Figure S3**

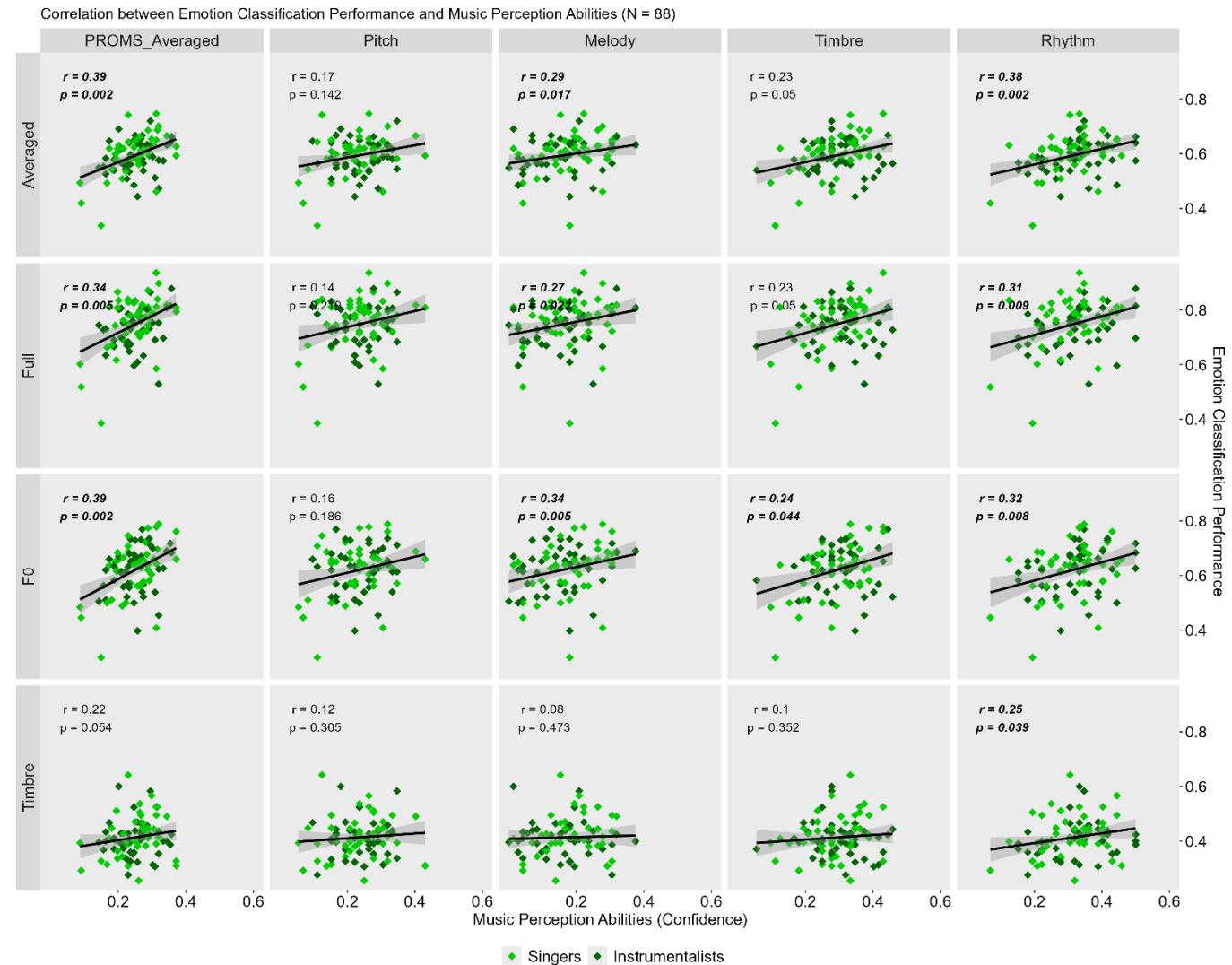
*Confusion data for each Emotion for the three Morph Types – Instrumentalists only*

Classification Proportion in %	Full					F0				Timbre				
	Sad-	Hap	Ple	Fea	Sad	Sad-	Hap	Ple	Fea	Sad	Sad-	Hap	Ple	Fea
	2	15	20	73	41	7	27	25	66	19	26	34	49	
Fee-	3	5	64	14	19	6	11	56	16	18	14	33	23	
Ple-	3	66	6	10	24	10	49	10	14	20	41	17	20	
Hap-	93	14	10	3	15	78	13	10	4	42	18	16	8	
	Hap	Ple	Fea	Sad	Avg	Hap	Ple	Fea	Sad	Hap	Ple	Fea	Sad	
	Emotion					Emotion				Emotion				

*Note. Numbers represent the proportion of classification responses per Emotion and Morph Type, averaged across non-musicians. Hap = happiness, Ple = pleasure, Fea = fear, Sad = sadness, Avg = average.*

**Figure S4**

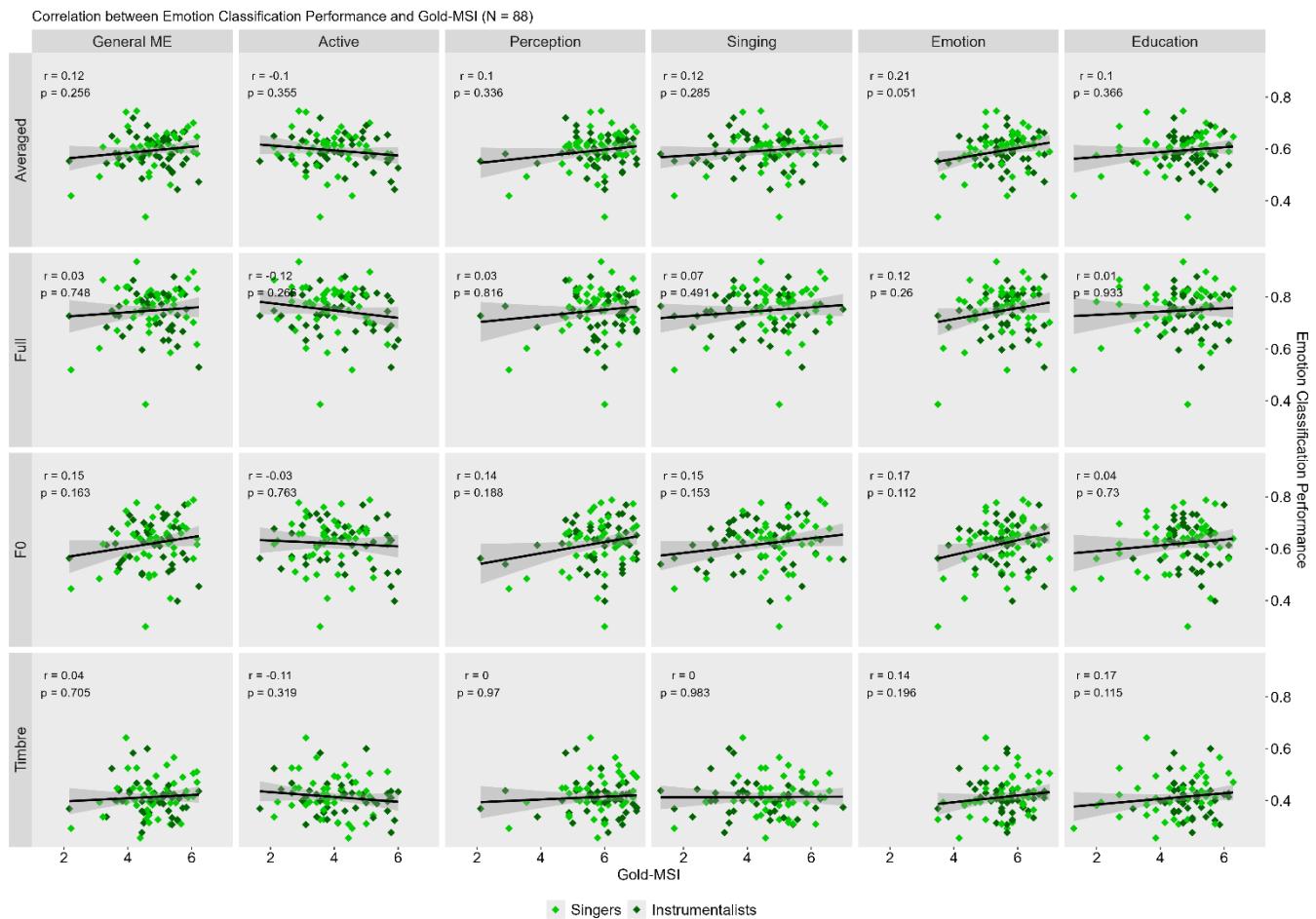
*Correlation between Emotion Classification Performance and Music Perception Abilities (PROMS)*



*Note.* Correlations are not controlled for formal musical education. The x-axis shows the different subtests of the PROMS (Pitch, Melody, Timbre, and Rhythm) as well as the averaged performance across all subtests (PROMS\_Averaged). The y-axis shows the vocal emotion classification performance separately for each Morph Type (Full, F0 and Timbre) and averaged across Morph Types (Averaged). Correlations are not controlled for formal musical education. p-values were adjusted for multiple comparisons using the Benjamini-Hochberg correction (Benjamini & Hochberg, 1995)

**Figure S5**

*Correlation between Emotion Classification Performance and self-rated Music Skills (GOLD-MSI)*



*Note.* The x-axis shows the different subscores of the Gold-MSI (Active, Perception, Singing, Emotion, and Education) as well as the General Music Education score (General ME). The y-axis shows the vocal emotion classification performance separately for each Morph Type (Full, F0 and Timbre) and averaged across Morph Types (Averaged). Correlations are not controlled for formal musical education. p-values were adjusted for multiple comparisons using the Benjamini-Hochberg correction (Benjamini & Hochberg, 1995)

**Table S3 – PROMS and VER, correlations**

	PROMSAvg	Pitch	Melody	Timbre	Rhythm
VERAvg	.39 (.002)	.17 (.142)	.29 (.017)	.23 (.050)	.38 (.002)
Full-Morphs	.34 (.005)	.14 (.219)	.27 (.022)	.23 (.050)	.31 (.009)
F0-Morphs	.39 (.002)	.16 (.186)	.34 (.005)	.24 (.044)	.32 (.008)
Timbre-Morphs	.22 (.054)	.12 (.305)	.08 (.473)	.10 (.352)	.25 (.039)

Note. *VER* = Vocal Emotion Recognition performance. *p*-values of Tables S9 – S12 were adjusted for multiple comparisons using the Benjamini-Hochberg correction (Benjamini & Hochberg, 1995). Table S3 is identical with Table 3 from the manuscript.

**Table S4 – PROMS and VER, controlled for musical education**

	PROMSAvg	Pitch	Melody	Timbre	Rhythm
VERAvg	.38 (.003)	.15 (.204)	.27 (.023)	.22 (.066)	.36 (.003)
Full-Morphs	.35 (.005)	.14 (.212)	.28 (.023)	.23 (.058)	.32 (.008)
F0-Morphs	.39 (.003)	.15 (.204)	.34 (.006)	.24 (.053)	.32 (.008)
Timbre-Morphs	.18 (.124)	.08 (.503)	.05 (.673)	.08 (.499)	.22 (.062)

Note. *VER* = Vocal Emotion Recognition performance.

**Table S5 – MSI and VER, correlations**

	General Sophistication	Active Engagement	Musical Training	Emotions	Singing Abilities	Perceptual Abilities
VER <sub>Avg</sub>	.12 (.256)	-.1 (.355)	.10 (.366)	.21 (.051)	.12 (.285)	.10 (.336)
Full-Morphs	.03 (.748)	-.12 (.266)	.01 (.933)	.12 (.260)	.07 (.491)	.03 (.816)
F0-Morphs	.15 (.163)	-.03 (.763)	.04 (.730)	.17 (.112)	.15 (.153)	.14 (.188)
Timbre-Morphs	.04 (.705)	-.11 (.319)	.17 (.115)	.14 (.196)	.00 (.983)	.00 (.970)

Note. *VER* = Vocal Emotion Recognition performance.

**Table S6 – MSI and VER, controlled for musical training**

	General Sophistication	Active Engagement	Emotions	Singing Abilities	Perceptual Abilities
VER <sub>Avg</sub>	.08 (.627)	-.16 (.509)	.19 (.509)	.09 (.627)	.07 (.627)
Full-Morphs	.04 (.769)	-.14 (.509)	.13 (.534)	.07 (.627)	.02 (.829)
F0-Morphs	.16 (.509)	-.06 (.711)	.17 (.509)	.15 (.509)	.14 (.509)
Timbre-Morphs	-.09 (.627)	-.21 (.509)	.08 (.627)	-.05 (.731)	-.07 (.627)

Note. *VER* = Vocal Emotion Recognition performance.

**Table S7**

Post-hoc tests on the AQ for professionals vs. non-musicians

	Pro-	Non-	<i>t</i>	<i>df</i> <sup>a</sup>	<i>p</i>	Cohens <i>d</i>
	professionals	musicians				
<i>AQ</i>						
Total	15.7 (4.98)	17.58 (6.41)	-1.44	69.83	.154	-0.34 [-0.82, 0.13]
Attention to Detail	<b>5.43 (2.04)</b>	<b>4.32 (2.01)</b>	2.42	75.87	.018	0.56 [0.09, 1.01]
Social	<b>10.28 (4.70)</b>	<b>13.26 (6.51)</b>	-2.32	67.08	.024	-0.57 [-1.05, -0.08]
Social Skills	<b>1.48 (1.68)</b>	<b>2.61 (2.63)</b>	-2.25	62.40	.028	-0.57 [-1.07, -0.06]
Communication	1.85 (1.61)	2.39 (1.73)	-1.44	74.83	.155	-0.33 [-0.79, 0.13]
Imagination	2.18 (1.52)	2.87 (1.95)	-1.75	69.92	.085	-0.42 [-0.89, 0.06]
Attention Switching	4.78 (1.91)	5.39 (1.92)	-1.43	75.75	.158	-0.33 [-0.78, 0.13]

<sup>a</sup>Note that original degrees of freedom were 76 but were corrected due to unequal variance.**Table S8**

Post-hoc tests on the AQ for professionals vs. amateurs

	Pro-	Amateurs	<i>t</i>	<i>df</i> <sup>a</sup>	<i>p</i>	Cohens <i>d</i>
	professionals					
<i>AQ</i>						
Total	<b>15.7 (4.98)</b>	<b>18.73 (7.40)</b>	-2.72	107.7	.008	-0.52 [-0.91, -0.14]
Attention to Detail	5.43 (2.04)	5.51 (2.42)	-0.21	88.61	.835	-0.04 [-0.46, 0.37]
Social	<b>10.28 (4.70)</b>	<b>13.22 (6.49)</b>	-2.90	101.8	.005	-0.57 [-0.97, -0.18]
Social Skills	<b>1.48 (1.68)</b>	<b>2.74 (2.49)</b>	-3.36	107.8	.001	-0.65 [-1.03, -0.26]
Communication	1.85 (1.61)	2.49 (2.12)	-1.88	97.42	.063	-0.38 [-0.78, 0.02]
Imagination	2.18 (1.52)	2.66 (1.81)	-1.57	89.18	.120	-0.33 [-0.75, 0.09]
Attention Switching	4.78 (1.91)	5.33 (2.06)	-1.48	80.83	.142	-0.33 [-0.77, 0.11]

<sup>a</sup>Note that original degrees of freedom were 126 but were corrected due to unequal variance.**Table S9**

Post-hoc tests on the AQ for amateurs vs. non-musicians

	Amateurs	Non-	<i>t</i>	<i>df</i> <sup>a</sup>	<i>p</i>	Cohens <i>d</i>
		musicians				
<i>AQ</i>						
Total	18.73 (7.40)	17.58 (6.41)	-0.88	80.44	.382	-0.2 [-0.63, 0.24]
Attention to Detail	<b>5.51 (2.42)</b>	<b>4.32 (2.01)</b>	-2.87	83.53	.005	-0.63 [-1.07, -0.19]
Social	13.22 (6.49)	13.26 (6.51)	0.04	70.10	.970	0.01 [-0.46, 0.48]
Social Skills	2.74 (2.49)	2.61 (2.63)	-0.27	67.11	.791	-0.06 [-0.54, 0.41]
Communication	2.49 (2.12)	2.39 (1.73)	-0.26	85.06	.795	-0.06 [-0.48, 0.37]
Imagination	2.66 (1.81)	2.87 (1.95)	0.57	65.93	.574	0.14 [-0.34, 0.62]
Attention Switching	5.33 (2.06)	5.39 (1.92)	0.17	74.89	.865	0.04 [-0.41, 0.49]

<sup>a</sup>Note that original degrees of freedom were 124 but were corrected due to unequal variance.

**Table S10**

Post-hoc tests on the Gold-MSI for professionals vs. non-musicians

	Pro-	Non-	<i>t</i>	<i>df</i> <sup>a</sup>	<i>p</i>	Cohens <i>d</i>
	fessionals	musicians				
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )				
<i>Gold-MSI</i>						
General ME	<b>5.68 (0.50)</b>	<b>2.74 (1.07)</b>	15.45	51.63	<.001	4.30 [3.30, 5.28] ***
Active Engagement	<b>4.94 (0.81)</b>	<b>2.95 (1.19)</b>	8.55	64.53	<.001	2.13 [1.51, 2.73] ***
Formal Education	<b>5.95 (0.56)</b>	<b>1.71 (0.68)</b>	30.10	71.67	<.001	7.11 [5.85, 8.36] ***
Emotion	<b>5.88 (0.73)</b>	<b>4.95 (1.32)</b>	3.79	56.87	<.001	1.00 [0.45, 1.55] ***
Singing	<b>5.34 (0.83)</b>	<b>2.84 (1.26)</b>	10.3	63.49	<.001	2.59 [1.91, 3.25] ***
Perception	<b>6.31 (0.51)</b>	<b>4.22 (1.49)</b>	8.19	45.10	<.001	2.44 [1.66, 3.20] ***

<sup>a</sup>Note that original degrees of freedom were 76 but were corrected due to unequal variance.**Table S11**

Post-hoc tests on the Gold-MSI for professionals vs. amateurs

	Pro-	<i>t</i>	<i>df</i> <sup>a</sup>	<i>p</i>	Cohens <i>d</i>	
	fessionals					
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )				
<i>Gold-MSI</i>						
General ME	<b>5.68 (0.50)</b>	<b>4.76 (0.82)</b>	7.80	116.1	<.001	1.45 [1.04, 1.85] ***
Active Engagement	<b>4.94 (0.81)</b>	<b>4.02 (1.00)</b>	5.54	91.98	<.001	1.16 [0.71, 1.59] ***
Formal Education	<b>5.95 (0.56)</b>	<b>4.66 (0.96)</b>	9.54	118.5	<.001	1.75 [1.33, 2.17] ***
Emotion	<b>5.88 (0.73)</b>	<b>5.55 (0.78)</b>	2.29	80.76	.025	0.51 [0.06, 0.95] *
Singing	<b>5.34 (0.83)</b>	<b>4.59 (1.19)</b>	4.08	105	<.001	0.80 [0.40, 1.19] ***
Perception	<b>6.31 (0.51)</b>	<b>5.75 (0.92)</b>	4.42	121.3	<.001	0.80 [0.43, 1.17] ***

<sup>a</sup>Note that original degrees of freedom were 126 but were corrected due to unequal variance.**Table S12**

Post-hoc tests on the Gold-MSI for amateurs vs. non-musicians

	Amateurs	Non-	<i>t</i>	<i>df</i> <sup>a</sup>	<i>p</i>	Cohens <i>d</i>
		musicians				
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )				
<i>Gold-MSI</i>						
General ME	<b>4.76 (0.82)</b>	<b>2.74 (1.07)</b>	-10.41	56.76	<.001	-2.76 [-3.48, -2.03] ***
Active Engagement	<b>4.02 (1.00)</b>	<b>2.95 (1.19)</b>	-4.81	60.26	<.001	-1.24 [-1.79, -0.68] ***
Formal Education	<b>4.66 (0.96)</b>	<b>1.71 (0.68)</b>	-19.67	97.53	<.001	-3.98 [-4.66, -3.29] ***
Emotion	<b>5.55 (0.78)</b>	<b>4.95 (1.32)</b>	-2.59	48.55	.013	-0.74 [-1.32, -0.16] *
Singing	<b>4.59 (1.19)</b>	<b>2.84 (1.26)</b>	-7.30	66.78	<.001	-1.79 [-2.35, -1.22] ***
Perception	<b>5.75 (0.92)</b>	<b>4.22 (1.49)</b>	-5.85	49.64	<.001	-1.66 [-2.30, -1.01] ***

<sup>a</sup>Note that original degrees of freedom were 124 but were corrected due to unequal variance.

**Table S13***PROMS post-hoc tests for professionals vs. non-musicians*

	<b>Pro-fessionals</b>	<b>Non-musicians</b>	<i>t</i>	<i>df</i> <sup>a</sup>	<i>p</i>	Cohens <i>d</i>
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )				
<i>PROMS</i>						
Pitch	<b>0.27 (0.06)</b>	<b>0.18 (0.06)</b>	6.25	75.77	<.001	1.43 [0.93, 1.94] ***
Melody	<b>0.23 (0.08)</b>	<b>0.07 (0.08)</b>	9.42	75.95	<.001	2.16 [1.59, 2.72] ***
Timbre	<b>0.32 (0.08)</b>	<b>0.26 (0.09)</b>	2.99	73.64	.004	0.70 [0.22, 1.16] **
Rhythm	<b>0.33 (0.08)</b>	<b>0.27 (0.08)</b>	3.52	75.96	<.001	0.81 [0.34, 1.27] ***

<sup>a</sup>Note that original degrees of freedom were 76 but were corrected due to unequal variance.**Table S14***PROMS post-hoc tests for professionals vs. amateurs*

	<b>Pro-fessionals</b>	<b>Amateurs</b>	<i>t</i>	<i>df</i> <sup>a</sup>	<i>p</i>	Cohens <i>d</i>
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )				
<i>PROMS</i>						
Pitch	<b>0.27 (0.06)</b>	<b>0.24 (0.07)</b>	2.57	87.32	.012	0.55 [0.12, 0.98] *
Melody	<b>0.23 (0.08)</b>	<b>0.16 (0.10)</b>	4.42	95.24	<.001	0.91 [0.48, 1.33] ***
Timbre	0.32 (0.08)	0.29 (0.08)	1.72	74.69	.090	0.40 [-0.06, 0.85]
Rhythm	0.33 (0.08)	0.32 (0.09)	0.80	84.27	.425	0.17 [-0.25, 0.60]

<sup>a</sup>Note that original degrees of freedom were 126 but were corrected due to unequal variance.**Table S15***PROMS post-hoc tests for amateurs vs. non-musicians*

	<b>Amateurs</b>	<b>Non-musicians</b>	<i>t</i>	<i>df</i> <sup>a</sup>	<i>p</i>	Cohens <i>d</i>
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )				
<i>PROMS</i>						
Pitch	<b>0.24 (0.07)</b>	<b>0.18 (0.06)</b>	-4.39	81.21	<.001	-0.97 [-1.43, -0.51] ***
Melody	<b>0.16 (0.10)</b>	<b>0.07 (0.08)</b>	-5.65	91.34	<.001	-1.18 [-1.62, -0.74] ***
Timbre	0.29 (0.08)	0.26 (0.09)	-1.88	62.25	.064	-0.48 [-0.98, 0.03]
Rhythm	<b>0.32 (0.09)</b>	<b>0.27 (0.08)</b>	-3.16	80.84	.002	-0.70 [-1.15, -0.25] ***

<sup>a</sup>Note that original degrees of freedom were 124 but were corrected due to unequal variance.

## 2. Supplemental Sample Information

**Table S16**

*List of reported instruments by amateurs (singers and instrumentalists)*

<b>Singers</b>	<b>Instrumentalists</b>		
Gesang ( <i>singing</i> ) / Chor ( <i>choir</i> )	35	Violine ( <i>violin</i> )	10
+ Klavier ( <i>piano</i> )	3	Posaune ( <i>trombone</i> )	6
+ Violine ( <i>violin</i> )	2	Cello ( <i>cello</i> )	5
+ Gitarre ( <i>guitar</i> )	2	Klarinette ( <i>clarinet</i> )	4
+ Bass ( <i>bass</i> )	1	Trompete ( <i>trumpet</i> )	4
+ Klavier ( <i>piano</i> ) and Cello ( <i>cello</i> )	1	Waldhorn ( <i>horn</i> )	2
+ Trompete ( <i>trumpet</i> )	1	Bratsche ( <i>Viola</i> )	2
		Schlagzeug ( <i>drums</i> )	2
		Bariton ( <i>bariton</i> )	1
		Bass ( <i>bass</i> )	1
		Fagott ( <i>bassoon</i> )	1
		Gitarre ( <i>guitar</i> )	1
		Klavier ( <i>piano</i> )	1
		Querflöte ( <i>flute</i> )	1
		Tuba ( <i>tuba</i> )	1
		Saxophon ( <i>saxophone</i> )	1

**Table S17***Socioeconomic background of amateurs (singers and instrumentalists)*

Income (in €)			Education		Degree			
	S	I		S	I		S	I
<1750	5	4	keine ( <i>none</i> )	0	0	keine ( <i>none</i> )	0	1
1750-2500	6	7	Schüler ( <i>pupil</i> )	0	1	Schüler ( <i>pupil</i> )	0	0
2500-3500	11	10	Hauptschule ( <i>secondary school</i> )	0	0	In Ausbildung ( <i>under training</i> )	15	17
3500-5000	17	9	Mittelschule ( <i>secondary school</i> )	0	0	Lehre ( <i>traineeship</i> )	0	3
>5000	6	13	Fachschule ( <i>technical college</i> )	1	1	Fachschule ( <i>technical college</i> )	1	0
			Abitur ( <i>A-levels</i> )	44	41	Meister ( <i>master craftsmen</i> )	0	0
						Bachelor ( <i>Bachelor</i> )	10	4
						Fachhochschulabschluss ( <i>Polytechnic degree</i> )	1	2
						Master/Diplom ( <i>Master/Diploma</i> )	14	10
						Promotion ( <i>PhD</i> )	4	6

$$\chi^2 = 5.23, \text{ df} = 4, p = 0.264 \quad \chi^2 = 1.06, \text{ df} = 2, p = 0.588 \quad \chi^2 = 9.06, \text{ df} = 7, p = 0.249$$

Note. This table presents the number of individuals belonging to different income, education, and degree categories. We tested group differences between singers (S) and instrumentalists (I) using a Chi-square test and show the results in the last line of this table. Please note that the response options "Education" (i.e. the type of school) and "Degree" (i.e. the highest professional qualification) were tailored to the German educational system and are therefore difficult to translate. Further, please note that "Fachschule" and "Abitur" are similar as they both enable a person to pursue a university degree (with a few more constraints for a "Fachschule" degree). We therefore consider the trend observed for the "Education" factor merely as an artefact of the response format. S = Singers, I = Instrumentalists

### 3. Supplemental Stimulus Information

**Table S18**

*Summary of the acoustic characteristics of female voice morphs separately for each Emotion and Morph Type*

MType	F0 Mean	F0 SD	F0 Glide	FormDisp	HNR
<i>Happiness</i>					
Full	348	98	-112	993	19
F0	348	98	-112	1096	20
Timbre	247	25	-37	981	19
<i>Pleasure</i>					
Full	185	21	-32	1131	19
F0	185	21	-32	1094	19
Timbre	247	25	-37	1122	20
<i>Fear</i>					
Full	288	30	28	1112	21
F0	288	30	28	1093	21
Timbre	247	25	-37	1120	21
<i>Sadness</i>					
Full	219	19	-39	1090	22
F0	219	19	-39	1097	21
Timbre	247	25	-37	1085	22
<i>Average</i>					
Full	247	25	-39	1094	22

*Note.* All acoustical parameters were adapted from (McAleer et al., 2014) and extracted using Praat software (Boersma, 2018) and the F0 contour information from the TANDEM-STRAIGHT object in Matlab (MATLAB, 2020). F0 Glide =  $F0_{End} - F0_{Start}$ ; Formant Dispersion (FormDisp) = ratio between consecutive formant means (from F1 to F4, maximum formant frequency set to 5.5 kHz, window length 0.025 s); HNR (harmonics-to-noise ratio) was extracted with the cross-correlation method (mean value; time step = 0.01 s; min pitch = 75 Hz; silence threshold = 0.1, periods per window = 1.0).

**Table S19**

*Summary of the acoustic characteristics of male voice morphs separately for each Emotion and Morph Type*

MType	F0 Mean	F0 SD	F0 Glide	FormDisp	HNR
<i>Happiness</i>					
Full	259	89	-74	999	17
F0	259	89	-74	1037	17
Timbre	158	21	-43	985	15
<i>Pleasure</i>					
Full	121	18	-32	1064	14
F0	121	18	-32	1046	15
Timbre	158	21	-43	1058	14
<i>Fear</i>					
Full	191	23	-19	1077	17
F0	191	23	-19	1046	17
Timbre	158	21	-43	1074	17
<i>Sadness</i>					
Full	122	14	-47	1040	16
F0	122	14	-47	1049	16
Timbre	158	21	-43	1033	16
<i>Average</i>					
Full	158	21	-43	1047	17

*Note.* All acoustical parameters were adapted from (McAleer et al., 2014) and extracted using Praat software (Boersma, 2018) and the F0 contour information from the TANDEM-STRAIGHT object in Matlab (MATLAB, 2020). F0 Glide =  $F0_{End} - F0_{Start}$ ; Formant Dispersion (FormDisp) = ratio between consecutive formant means (from F1 to F4, maximum formant frequency set to 5.5 kHz, window length 0.025 s); HNR (harmonics-to-noise ratio) was extracted with the cross-correlation method (mean value; time step = 0.01 s; min pitch = 75 Hz; silence threshold = 0.1, periods per window = 1.0).

## 4. Supplemental Design Information

**Table S20**

*Summary of response key mappings to emotions*

	„d“	„f“	„j“	„k“
CB 1	happiness	pleasure	sadness	fear
CB 2	sadness	fear	happiness	pleasure
CB 3	pleasure	happiness	fear	sadness
CB 4	fear	sadness	pleasure	happiness

*Note.* Participants were instructed explicitly to press the keys „d“ and „f“ with their left index- and middle-finger and the keys „j“ and „k“ with their right index- and middle-finger. CB = counterbalancing condition.

**Table S21**

*Participant assignment to the different response key mapping*

	Singers	Instrumentalists
CB 1	11	10
CB 2	10	12
CB 3	16	8
CB 4	8	13

*Note.* Participants were randomly assigned to key mappings. CB = counterbalancing condition.

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